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USING GIS TO ANALYZE WETLAND BASINS IN NORTHCENTRAL NORTH DAKOTA

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A major requirement for effective habitat management is the knowledge of the physical and vegetative attributes within an ecosystem. These data are unique to each ecosystem, and gathering these data is time consuming and expensive. The advent of affordable Geographical Information Systems (GIS), now available for use in personal computers, gives ecologists a new and powerful tool.

GIS is a combination of hardware and software capable of analyzing spatial and temporal changes occurring over large geographical areas. The GIS software package created by MicroImages[1] Inc., Lincoln, Nebraska, allows for overlaying of various cartographic components on a digitized map image. There can be several overlays on one map image. For example, the overlays can be soil type, elevation, slope, aspect, hydrology, ground cover, vegetation composition, and land use. Databases (e.g., Lotus 1-2-3), containing pertinent information on individual components of land features, can be attached to the overlays. Additionally, statistics from these data can be generated on such variables as perimeters, areas, and fractal dimensions (area:perimeter ratios) for objects of interest within the map image.

We are using GIS to monitor the effects of herbicide application to cattail-choked wetland basins in North Dakota. Dense stands of cattail (*Typha* spp.) often serve as roost sites for large aggregations of migrating blackbirds (*Icterinae*) in August and September. Elimination of roost-site vegetation by the application of herbicides or other methods (e.g., burning and cutting) has the potential to move blackbirds, which often cause extensive agricultural damage on a local scale (Otis and Kilburn 1988). Starting in 1989, Linz et al. (1992) treated cattail-choked wetlands in northcentral North Dakota with RODEO®, a glyphosate-based herbicide. Research on the environmental effects of altering the vegetative composition within the treated wetlands continues. The objectives of our study are to: (1) use GIS to estimate cattail densities and vegetation coverages in blackbird roosts and (2) use

[1] Use of any product mentioned in this report does not constitute an endorsement.

GIS to monitor the regrowth of cattail in wetlands treated with RODEO®.

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STUDY AREA AND METHODS

The study area is in the Drift Plains physiographic region of northcentral North Dakota. The region is characterized by flattened or gently rolling terrain and numerous, shallow, wetland basins. A majority of the tillable land is dedicated to either wheat, barley, or sunflower production.

Control and treated wetlands in Benson, Nelson, Walsh, and Grand Forks counties were photographed from a fixed-winged aircraft at 305-457 m above ground level. All photographs were taken vertically from a port cut in the belly of the aircraft. Flight speeds were between 117-145 kph. Missions were flown on cloudless days between 1100-1500 h to achieve maximum light intensity and sun-angle. In addition to the pilot and photographer, a copilot was used to direct the overlapping flight paths needed to photograph the larger wetlands. The wetlands were photographed with a 60% forward overlap between successive photographs and a 20% lateral overlap between adjacent flight strips (Higby et al. 1987, Lo 1986). We used Kodak Ektachrome Infrared Film Type IE 135-36 and a 35 mm, motor-driven, SLR Cannon EOS650 camera with a 50 mm lens. A Kodak Wratten #12 filter was placed over the lens to subtract blue light. The film speed was set at 100 ASA, and the camera shutter speed was 1/500 sec. Test photography of the wetlands indicated that CIR photographs should be underexposed 1.5 *F*-stops below the recommended light reading for white light. The majority of the photographs were taken at a *F*-stop of 5.6. Unexposed film was stored at 0^0 C in a freezer, with a relative humidity of 40-60% (Flowerday 1982, Graham and Read 1986). Film was removed from the freezer 4 h before use and allow to warm up to room temperature. The exposed film was shipped over-night mail to Precision Photo Laboratories, Dayton, Ohio; this laboratory uses the EA-5 developing process for CIR film. The film was mounted as slides and digitally scanned into the computer with a Nikon LS-3500 35 mm film scanner. Micro-Image Processing Software was used to obtain areal coverages of vegetation and open water within each marsh. Additionally, vegetation species were identified by the color differences produced by the CIR. Wetland basins that were photographed were ground-truthed to correlate the information acquired through CIR photography and to obtain physical measurements for verification of photographic scale.

RESULTS AND DISCUSSION

MIPS was able to distinguish approximately 100 shades of color per slide. Dense, healthy cattail was represented by various shades of dark red. As the density of the cattail decreased, the signature would range from a rust color to a reddish-olive color, depending on the species composition of the understory (e.g., composite or dead cattail from previous years and water depth). Dead cattails had CIR signatures ranging from blue to light-green. Apparently, enough color separation exists in CIR to distinguish freshly killed cattails (green)

from cattails killed in previous years (pale blue). If the density of living cattail was sparse, the dead vegetation in the understory would dominate and yield a green color; the resolution would have to be increased to detect low-density cattails. Dryland vegetation surrounding the cattails was bright red to hot pink and easily distinguishable from vegetation located directly in the wetland. One species of composite (aster) found in dry marshes had a color very similar to healthy, moderately dense cattail; this species was found in 2 dry marshes growing in alkaline soils. Both bare ground and alkaline soils were white in CIR. The signature for phragmites (*Phragmites maximus*) was light pink and separable from cattail. Duckweed (*Lemna* spp.) was grayish-white. Open water was black. The resolution for solid objects (e.g., waterfowl nesting platforms, rocks) was approximately 0.25 m^2.

FUTURE RESEARCH

We plan to continue developing GIS as a tool for identifying factors related to the establishment of blackbird roosts in cattail marshes. In particular, research quantifying the relationship of cattail marshes, ripening sunflower, and blackbird numbers is needed. GIS computer software will enable scientists to analyze large, complex data sets involving many habitat variables. Only after we understand these variables in relation to sunflower damage patterns, can a comprehensive integrated pest management plan be developed and implemented.

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